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ESTIMATION AND SPATIAL INTERPOLATION OF AVERAGE MONTHLY WIND SPEED

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1. Introduction

Average monthly wind speed at or about 10 metres above ground is archived in computer media for stations (in Great Britain) with anemometers for years since 1930. For earlier years this statistic is not archived at all, even for stations with continuous records, and the labour needed to calculate it, where sufficient data exist, has not been available. Furthermore in early years the network of anemometers was sparse and heavily biased to coastal areas. Estimates of wind speeds for stations measuring duration of bright sunshine and air temperature have been made from the 1880's onwards using a method proposed by Wales-Smith (1977) to contribute wind data to the data-set described by Wales-Smith and Wiltshire (1979). The availability of average monthly wind speeds from some stations from 1930 onwards raised the question of the method to be used thereafter in estimating average speeds for stations with no wind speed data.

By Wales-Smith's method a coarse estimate of average monthly wind speed may be obtained from average monthly isobaric charts using an empirically adjusted geostrophic wind scale. If averages of measured wind speed are available from a sufficient network of stations it is appealing to try to interpolate, directly, to ungauged points (stations without wind speed records) rather than to use an indirect method. The method considered likely to be most successful was to adjust the average speed at a station to give an estimate for another, reasonably close station by means of inter-station climatological relationships. The relationship suggested was that obtainable from a chart of hourly mean wind speed exceeded for 50% of time at 10 metres above ground (Caton, 1976).

Two other methods have been examined. The first is similar to that just described and uses inter-station relationships obtained from annual average wind speeds for 1961 to 70 (Meteorological Office, 1976.) The second, included mainly to demonstrate that skill can be obtained by other methods, is a simple assumption that the average monthly wind speed at inland stations in Great Britain is always 9.0 knots and at coastal stations 10.3 knots.

2. Calculations and Comparisons of Results

The pairs of stations marked in Figure 1 were used in the comparison of accuracies of methods. All stations were used in the two station relationship methods and in the "standard speed" method. The pairs of stations marked with circled dots, only, were used in the pressure chart method. All stations used measured the wind speed so estimates could be tested in all cases. Differences between estimated and measured wind speeds were expressed as percentage of the latter. A simple comparison is shown in Table 1.

Table 1. Percentage of Cases of Estimates Attaining Accuracies ± 15% and ± 30% of Measured (Average) Wind Speeds

Year	Method a (Caton relationships)		Method b (1961-70 relationships)		Method c (Standard speed)		Method d (Pressure chart)	
	± 15%	± 30%	± 15%	± 30%	± 15%	± 30%	± 15%	± 30%
1977	51	87	35	83	50	83	42	71
1978	68	94	53	92	55	87		

It is apparent from a study of monthly results from individual stations that Method d results could be improved by the use of empirical adjustment factors but this is probably also the case with Method a. The Method d estimates can be artificially improved to 70% and 90% respectively by normalising, but so good a result as this could not be expected from routine empirical adjustment. Method b was, clearly not successful. The modest success of Methods a and c shows that in some years skill is not impressive but in others there is a clear gain in using an objective method.

The inclusion of a high proportion of coastal stations, where wind speeds are generally higher than inland, puts all methods and estimations to a severe test. Many coastal stations have topographical peculiarities which enhance the speed of the wind from seaward directions.

A weakness of Method d is that it systematically under-estimates speeds at coastal stations, whereas Method a does not appear to give biased results.

3. Conclusions

This pilot investigation, carried out by hand with limited labour, confirms the intuitive view that the direct method of interpolating wind speeds is appreciably better than the indirect method of estimating speeds from pressure maps and it has therefore been used from 1930 onwards.

References

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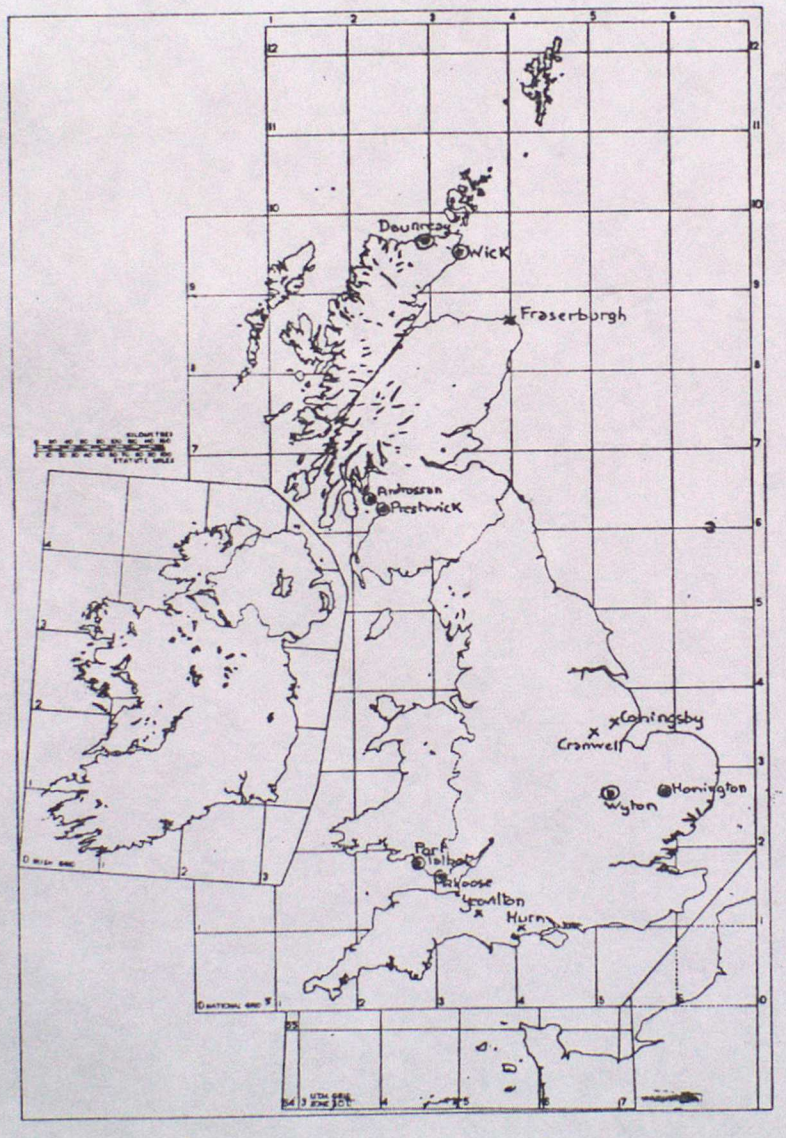

Figure 1. Stations used in pilot investigation.